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Exploring the Acceptability of Google Glass as an Everyday Assistive Device for People with Parkinson's

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ABSTRACT

We describe a qualitative study investigating the acceptability of the Google Glass eyewear computer to people with Parkinson's disease (PD). We held a workshop with 5 PD patients and 2 carers exploring perceptions of Glass. This was followed by 5-day field trials of Glass with 4 PD patients, where participants wore the device during everyday activities at home and in public. We report generally positive responses to Glass as a device to instil confidence and safety for this potentially vulnerable group. We also raise concerns related to the potential for Glass to reaffirm dependency on others and stigmatise wearers.

INTRODUCTION

Parkinson's disease (PD) is a progressive neurological condition affecting up to 10 million people worldwide, with onset generally in those over 50 [9]. PD manifests itself in motor symptoms including rigidity, tremor and bradykinesia, or slowness of movement [2]. These affect balance, gait, arm and facial movements. Motor blocks (freezing) most commonly affect an individual's legs during walking and is generally referred to as freezing of gait. Speech and voice are also typically affected in terms of volume and clarity. People with PD can also be prone to transient and unpredictable "ON/OFF" cycles, wherein medication becomes less effective at treating symptoms, giving periods of effectively controlled symptoms (ON) and periods of severe symptoms (OFF). Aside from the physical signs of PD there are a myriad of emotional and

social factors relating to loss of independence, self-confidence, embarrassment and stigma [7].

Prior work has explored the use of wearable technology to help the self-management of PD symptoms (e.g. [1, 8]) with further work primarily focusing on diagnostics and tremor classification e.g. [5]. One of the major recent wearable computing breakthroughs is Google's new 'eyewear computer', expected to be commercially available in 2014, referred to as *Glass* [6]. Eyewear computers are claimed to be the next evolution beyond smartphones. Glass is designed to resemble, as much as possible, normal off-the-shelf spectacles. Yet it is equipped with a miniature computer, a micro-display and contains many sensors: an inertial measurement unit (gyroscope, compass and accelerometer) to measure head movements, a microphone for ambient sound pickup, a capacitive touch sensor on the main housing and a front-facing camera. Interaction with Glass is through touch gestures on the side of the frame and spoken commands. Additionally, Glass can provide audio and visual information to a wearer through a bone conducting speaker and the translucent display filling a small region of the field of view. It can be connected via Bluetooth to a mobile phone to access its sensor data (e.g. GPS or additional motion sensors) or the Internet.

Glass opens a new space for exploring the design and development of wearable context-aware systems. As a commercial device it might avoid the stigma associated with devices designed specifically for people with a condition [8]. However, given the novelty of Glass, the expectations and possible acceptance of such devices are not yet known. We fill this void by presenting a qualitative study based on workshop discussions and an initial field trial of the Glass device with people with PD from the United Kingdom.

THE STUDY

First, we undertook a 'Hands on the Glass' workshop with 5 people with PD, representing a diverse range of typical symptoms, and 2 carers. Participants were aged between 46-70 and all were supportive of research and interested in the idea of Glass. The workshop gathered qualitative insights about how participants currently use technology both socially and in managing their condition and to gather initial reactions to the Google Glass technology. Second,

we undertook a series of 5 day-long field trials of the Google Glass with 4 of the participants with PD, with daily phone interviews and an exit interview. The workshop and interviews were audio recorded, which were transcribed and anonymised for later analysis. We conducted an inductive thematic analysis [4] on transcribed data by coding it at the sentence to paragraph level and drawing out themes across the data set. The quotes used to describe themes illustrate themes drawn across all participants and data, with the exception of instances where we focus on individual differences (e.g. the 'Wearing the Glass out and about' section). Participant comments are denoted in the text as per; being Parkinson's or carer (P/C), gender (M/F) and participant number (1-7).

HANDS ON THE GLASS WORKSHOP

The 'Hands on the Glass' workshop lasted approximately 2 and a half hours. All 5 of the participants with PD who took part owned mobile phones and used the internet at home, with 3 using specific applications to manage their condition. One participant owned and used a Wii. The workshop began with open discussion about how participants used technology to support daily routines, social activities, and manage their PD. This revealed how many of the participants felt privileged by being able to leave their home and be independent. It was also clear that, while all the participants used mobile phones, they became deeply frustrated by an inability to manipulate them due to hand tremors. Following this discussion, a promotional video of Glass was played, highlighting the video calling, photo sharing, social media, street directions, and information searching features of the device. Following this a researcher gave a demonstration of Glass. Each participant was then given the opportunity to wear and use Glass for a short period of time. Group discussions were facilitated throughout, with the purpose of gathering views on what Glass could do 'out of the box' and encouraging participants to express ideas of alternative uses for the device. The thematic analysis of the workshop revealed 4 themes, discussed in the following.

Issues and Frustrations Relating to Technology Usage

Participants discussed issues they experienced with existing technologies at length. There were particular problems with smartphones specifically related to PD. Tremor and a loss of fine motor ability were identified as symptoms causing great difficulty with using touchscreens and a major source of frustration (PF6: *"the movements have to be quite precise with a touchscreen and if your hand is rigid and not moving very well it's no good really"*). This linked into discussion around needing to place the phone on a stable surface in order to use it (PF5: *"I have to put the phone down to use the touchscreen and it's very, very tricky"*). Participants therefore felt that having a voice activation system would be a huge benefit for them (PF5: *"definitely some kind of hands free - it's definitely the only option for someone with PD"*). Having this on an easily accessible platform such as Glass was

perceived to be immensely advantageous when compared with a typical mobile phone based hands free systems.

However, voice command was not without its issues. Many people with PD experience severe problems with their speech and voice which can change with ON/OFF periods. PM3 in particular had marked difficulty producing intelligible speech, which often caused him to avoid certain situations or social interactions: *"This [his voice] is not right... It's frustrating. You can't get rid of this [...] Now it's really worse, so now I tend to wait for me to be better [...] There's no point in carrying on a conversation if you can't understand me"*). This led to concerns from PM3 and other participants that the spoken commands would not work unless highly personalised to specific vocal gestures. Following the 'trying on the Glass' activity, however, there was a high level of success experienced by the participants using the voice activation, including PM3, which incited a sense of encouragement.

Confidence and Safety

All PD participants explained how they had lost confidence as a result of the sudden physical changes associated with unpredictable OFF stages, e.g. PM2 experienced severe and frequent difficulties with freezing, causing him anxiety in crowds or when out alone. This would lead to situations where they were liable to fall or be unable to get required help from the public (PF6: *"well, you lose confidence because you can fall...people don't always understand what you're saying...your voice gradually wears out"*). Glass was immediately seen as something that could instil confidence for participants by providing a feeling of safety. Participants felt they could be independent and go out on their own in the knowledge they could quickly contact someone who could *"see where they are"* and offer instruction and support (PF6: *"It would give me confidence back. I would be more independent because I'm not allowed to be independent much at the moment. That would give anyone in that position the confidence back to be able to be on their own."*). Supporting increased confidence and safety would be two-way between patient and carer. Carers would also benefit from knowing their family member could be contacted as and when needed (CF7: *"Having that, that person can [...] see that you're fine and everything"* and PF6: *"the carer would have more confidence in the cared for and the person would have more confidence in themselves to be able to go out and about"*). However, there was also the consideration of burdens for the carer, who may not want to be looking over the person at all times (CM4: *"I wouldn't want to be watching your every move"*).

Security and Vulnerability

Concerns emerged over personal security and the potential that criminals would want to steal the device due to its expense (\$1500 +) and rarity (PF5: *"I think at the moment while they're still so pricey I'd be worried that someone was going to whip them off me."*). Participants felt the

constant visibility of Glass made them vulnerable, in the sense that it must be worn to be used. Feelings around security differed from those directed to mobile phones, which could be hidden and need not be on public display (PM1: *"You put the phone in your pocket [...] If you've got Glasses on here, they can be running past and have them away"*). However, despite these concerns there was an overwhelming sense that using the device could provide features that were worth potential security risks (PM1: *"it offers so much for you. [...] It's offering you more safety features than it's actually giving you a problem with"*).

Privacy

There was apprehension that video linking could be abused by overly concerned relatives, who might think they are helping but are instead using the device as a way to control family members with a medical condition. Participants felt that they would need full control over who was able to call them via video link in order to avoid this issue (PF6: *"I don't want my children watching every move I make. There is a potential there for saying, 'Mum can't do this', or, 'Mum shouldn't do that'."*). Concerns were also raised over *"always being available"*, in the sense that relatives would expect Glass to be easily accessible at all times. This was contrasted with a mobile phone where excuses could be made about why it was not answered (CF7: *"You cannot say, 'Oh, I haven't got my mobile with me'"*).

FIELD TRIALS

The second phase of the study was a series of field trials wherein 4 participants were provided with an operational Glass to use in their own time for 5 days. All participants had PD and had participated in the earlier workshop. PM1 and PM3 wore a black Glass while PM2 and PF5 wore blue. For the trials we provided participants with a boxed Glass, a Google Nexus 4 phone to tether it to, a basic instruction booklet on how to operate Glass, and cables for charging (Glass lasted approximately 5 hours with full charge). At the start of the trial a researcher demonstrated and explained how to use the device. Participants were informed that they could use Glass as much as they wished. However, in an attempt to encourage interactions with the device we provided a pack of 5 prompt cards with activities for participants to perform each day. This included: requesting and following directions, taking photos, creating videos, checking the calendar, and making to do lists.

Each evening a researcher phoned the participants for a brief interview. These interviews identified any significant problems in using the device and also gauged general usage of the device. At the end of the trial each participant took part in an exit interview. These interviews focused on: where they wore the device, what they enjoyed using it for, where they felt it could be improved and to identify whether perceptions towards Glass had altered since the workshop. Each device was then wiped of all content. We describe the themes from the field-trial in the following.

Wearing Glass while 'Out and About'

All of the participants used Glass daily at home as well as in outdoor settings, such as the shopping mall (PF5), when meeting with friends (all), while out driving (PM1, PF5) and during a hospital appointment (PM1, PM2, PM3).

PF5 wore Glass to a busy shopping mall and reported receiving a lot of fleeting attention: *"most people would kind of look and then, out of politeness or whatever, would not pursue it"*. She invited conversation from several service staff and was surprised to hear that they had perceived her as having a visual impairment: *"I went into the bank and the coffee shop, the person serving me [...] kept looking. [...] I explained what they were and both of them said 'oh, I thought you had some kind of visual impairment'"*. This did not however make her feel uncomfortable and she felt the attention was not excessive.

PM1 took a different approach while shopping. He attempted to provoke a reaction from others but found they *"took no notice"* of him. PM3 had a very different experience however, as he removed his Glass while shopping because he: *"felt people were looking at me. They were staring. I found it quite hostile, it was almost like 'you're up to something'"*. This contrasted with the experiences of his wife (also his carer), who had worn Glass while out for lunch with a friend and felt that *"no one noticed"*. PM3 stated *"it's different for you because your hair hides it"* indicating that he did not want Glass to draw undue attention to him. This possibly related to a lack of confidence PM3 feels in his daily life due to his poor speech, which sees him often avoid social interactions with people he does not know. He associated the unwanted attraction with a feeling of disability: *"people peer at you, it's almost like the blue [disabled] badge on the car - they peer inside to look at you as if to say 'what's wrong with you?' That's how I felt"*. For PM3 the visibility of the device on his head was a source of stigma. Similar concerns were raised by PM2, who wore a light blue Glass during the trial: *"They should be black so people don't notice it"*. 3 out of 4 of the participants also reported that they would not wear Glass in particular settings due to concerns over their safety.

Frustrations when Interacting with Glass

All of the participants experienced usability issues with Glass. The voice recognition caused frustration amongst everyone (PF5: *"the fact that it wasn't recognising what I wanted was very irritating and very frustrating"*). For PM2 and PM3, who already have marked difficulties with their speech through PD, this proved deeply disheartening (PM3 *"my voice wasn't always working...it came up saying 'try again'"*; PM2's wife: *"he had to shout at it a few times because obviously his voice is very quiet"*). It was noted that, for PM1, *"the voice application is going to have to be re-engineered and made a bit easier"* in order for it to be usable for someone with PD. These difficulties contrasted

with the relative successes these same participants had when testing Glass in the workshop.

The navigation gestures, namely tapping on the side of the device, were also problematic in everyday use. There was more success when using the swiping gesture to navigate menus however (PM1: *"I found that the tapping was quite difficult... your hand just keeps going"*). PM2 also found this to be a difficult gesture to master *"scrolling backwards and forwards wasn't too good at times, sometimes you went too far and it was hard to get back"*.

Appreciating Glass

There were a number of successes experienced when using the preinstalled apps on Glass both at home and outdoors. The SatNav system in particular was appreciated: (PM1: *"it was very good, it was the most interactive one I've had...so accurate it's unbelievable"*). When working correctly participants were struck by the speed at which searches could be performed: (PM2: *"the information it gave you was great...it was very quick"*). That they did not have to get a phone out and deal with the resulting physical interaction problems was also valued: (PM1: *"I can't do that with a mobile phone but other people can"*; PM2: *"it's better than a phone. With Parkinson's you can't text because you can't hit the buttons. With the glass you would just talk, you can see what you're doing, it's just instant"*).

GLASS-BASED SELF-MANAGEMENT FUTURES

Across the workshop and deployment phases of our study reactions to Glass were, on the whole, positive. Some of this was down to the novelty of the technology, particularly for PM1, but there was also a genuine appreciation that the device could transform the lives of those with PD. Our aim with this study was to elicit rich initial impressions of Glass based upon the existing, rather limited, selection of apps and functions the device provides. Based on our findings and participant comments, however, Glass also has alternative applications that could potentially help someone with PD self-manage their symptoms.

Contextual Reminders and Prompts: There is great potential to utilise the on-board sensors to detect, and respond to, oncoming OFF periods for someone with PD [PM1, PM2, PF5]. Clinical studies have already shown the potential of using sensors to detect ON/OFF motor fluctuations [3]. Context aware medication reminders and information logging capabilities could prove advantageous in the monitoring and management of medication use [PF5], providing both clinicians and the individual with PD an insight into how well their medications are working.

In-Sight Task Support: The sense of loss of ability, independence and self-confidence was palpable throughout the workshop, thus attempting to recover this in some small way could make a vast difference to the life of someone with PD. Glass allows for instant feedback and support during tasks through the translucent display. This feature could have a positive impact both on the confidence and

independence of someone with PD, e.g., sharing what you see with a carer [PF6], or the SatNav system to aid oneself when out alone [PM1].

Cueing for Self-Management: Cueing for freezing has been shown to be successful for people with PD [1]. A person who is seemingly unable to move can be cued into initiation through having a simple visual cue in the form of someone's foot, a laser spot or a walking stick which they are then able to step over. Using a visual overlay displayed on Glass to provide a cue for people experiencing freezing episodes was suggested by several participants [PM1, PM2, PM3]. The cueing theme was extended with further ideas around situated cueing for posture correction, swallowing, blinking and speech [PM1, PF5].

CONCLUSION

Our study of Glass was with a small sample of PD patients and over a short trial period. However, initial impressions were very promising. Our findings show that there is worth in exploring the technical feasibility of applications for PD supporting reminding and prompting, in-sight task support and self-management cues. Future work will also need to address several of the basic functions of Glass, such as the voice recognition and navigation gestures, to ensure it can accommodate for usability issues caused by PD symptoms.

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